

CLAIMS

1. A heteropentamer composed of a fusion monomer comprising a fusion protein of an antigenic amino acid sequence and an amino acid sequence of a monomer of a mucous membrane-binding protein and a nonfusion monomer of an amino acid sequence of a monomer of a mucous membrane-binding protein.

2. The heteropentamer according to claim 1, wherein the antigenic amino acid sequence and the amino acid sequence of the mucous membrane-binding protein are joined via a linker.

3. The heteropentamer according to claim 1 or 2, wherein the mucous membrane-binding protein is an enterotoxin B subunit or cholera toxin B subunit.

4. The heteropentamer according to any one of claims 1 to 3, wherein the antigenic amino acid sequence is an antigen derived from an envelope protein of Japanese encephalitis virus.

5. A nucleic acid molecule encoding the fusion monomer and the nonfusion monomer of any one of claims 1 to 4, or a nucleic acid molecule complementary to the sequence encoding the fusion monomer and the nonfusion monomer.

6. A vector, which comprises the nucleic acid molecule of claim 5 and expresses the fusion monomer and the nonfusion monomer in a transformed host.

7. A homopentamer composed of a fusion monomer comprising a fusion protein of an amino acid sequence of an antigen derived from an envelope protein of Japanese encephalitis virus and an amino acid sequence of a monomer of a mucous membrane-binding protein.

8. A fusion monomer protein comprising an amino acid

sequence of an antigen derived from an envelope protein of Japanese encephalitis virus and an amino acid sequence of monomer of a mucous membrane-binding protein.

9. The fusion monomer protein of claim 10, which
5 comprises (1) the amino acid sequence of SEQ ID NO: 1; or
(2) an amino acid sequence resulting from deletion, substitution, insertion, and/or addition of one or more amino acids in the amino acid sequence of (1) and having Japanese encephalitis virus antigenicity and a mucous
10 membrane-binding property.

10. A nucleic acid molecule encoding the protein of claim 8 or 9, or a nucleic acid molecule complementary to the sequence encoding the protein of claim 8 or 9.

11. The nucleic acid molecule of claim 10, which is
15 defined by SEQ ID NO: 2.

12. A vector, which comprises the nucleic acid molecule of claim 10 or 11 and expresses the fusion monomer in a transformed host.

13. A host transformed with the vector of claim 12.

20 14. A host transformed with the vector of claim 6 or 12.

15. A vaccine comprising the heteropentamer of any one of claims 1 to 4, the homopentamer of claim 7, or the host of claim 14.

25 16. The vaccine of claim 15, which is enteric-coated and can be orally administered.

17. The vaccine according to claim 16, wherein the enteric coating comprises calcium.

18. A method for preparing a vaccine, which comprises the steps of:

30 integrating a gene sequence encoding a fusion protein

of an antigenic amino acid sequence and an amino acid sequence of a monomer of a mucous membrane-binding protein, and a gene sequence encoding an amino acid sequence of a monomer of a mucous membrane-binding protein into a gene of

5 a vector;

introducing the vector into a host for transformation;

expressing the vector to produce a heteropentamer composed of a fusion monomer of the fusion protein and a nonfusion monomer of the monomer; and

10 purifying the heteropentamer secreted in a culture solution by the host.

19. A method for intestinal immunization by orally administering the vaccine of any one of claims 15 to 17 or the host of claim 14 to a human or an animal.

15 20. A medicinal composition for intestinal immunization by oral administration, which comprises the vaccine of any one of claims 15 to 17 or the host of claim 14.